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IS : 4493 (Part II) - 1981
(Reaffirmed 2003)

Indian Standard

SPECIFICATION FOR HOLLOW METALLIC WAVEGUIDES

PART II ORDINARY RIGID RECTANGULAR WAVEGUIDES

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Indian Standard

SPECIFICATION FOR HOLLOW METALLIC WAVEGUIDES

PART II ORDINARY RIGID RECTANGULAR WAVEGUIDES

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Indian Standard
SPECIFICATION FOR HOLLOW METALLIC WAVEGUIDES
PART II ORDINARY RIGID RECTANGULAR WAVEGUIDES

0. FOREWORD

0.1 This Indian Standard (Part II) was adopted by the Indian Standards Institution on 11 May 1981, after the draft finalized by the Microwave Components and Accessories Sectional Committee had been approved by the Electronics and Telecommunication Division Council.

0.2 This standard shall be used in conjunction with IS : 4493 (Part I) -1979*.

0.3 Different types of wave types are being covered in a series of standards consisting of the following individual parts of IS : 4493:

Part I	General requirements and tests
Part II	Ordinary rigid rectangular waveguides
Part III	Medium flat rectangular waveguides
Part IV	Flat rectangular waveguides
Part V	Rectangular waveguides with circular outside cross-section
Part VI	Square waveguides
Part VII	Circular waveguides
Part VIII	Elliptical waveguides

0.4 While preparing this standard, assistance has been derived from the following:

a) IEC Pub 153-2 Hollow metallic waveguides : Part 2 Relevant specifications for ordinary rectangular waveguides. International Electrotechnical Commission.

b) JSS 53001 Detailed specification for wave-guides, rigid rectangular. Ministry of Defence.

0.5 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960†. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

---

[*] Specification for hollow metallic waveguides: Part I General requirements and tests (*first revision*).

[†] Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard (Part II) specifies the requirements for hollow metallic tubing, ordinary rigid rectangular waveguides Type R for use in electronic and telecommunication equipment.

2. TERMINOLOGY

2.1 For the purpose of this standard, the terms and definitions given in IS : 1885 (Part XIII/Sec 2) - 1967* and IS : 4493 (Part I) - 1979† shall apply.

3. CLIMATIC CATEGORIES

3.1 Provisions of **3** of IS : 4493 (Part I) - 1979† shall apply.

4. MATERIAL CONSTRUCTION AND WORKMANSHIP

4.1 Provisions of **4** of IS : 4493 (Part I) - 1979† shall apply.

5. DESIGNATION OF WAVEGUIDES

5.1 Provisions of **6** of IS : 4493 (Part I) - 1979† shall apply.

6. MARKING

6.1 Provisions of **7** of IS : 4493 (Part I) - 1979† shall apply.

7. PACKAGING

7.1 Provisions of **8** of IS : 4493 (Part I) - 1979† shall apply.

8. DIMENSIONAL REQUIREMENTS

8.1 The outline and dimensions shall be in accordance with Fig. 1 and Table 1.

9. ELECTRICAL CHARACTERISTICS

9.1 The electrical characteristics shall be as specified in Table 1.

10. CONDITIONS FOR TESTS

10.1 Provisions of **9.1** of IS : 4493 (Part I) - 1979† shall apply.

---

* Electrotechnical vocabulary: Part XIII Telecommunication transmission lines and waveguides, Section 2 Microwave transmission lines and waveguides.

† Specification for hollow metallic waveguides: Part I General requirements and tests (*first revision*).

11. CLASSIFICATION OF TESTS

11.1 Provisions of **9.2** of IS : 4493 (Part I) - 1979* shall apply.

11.2 The schedule for mechanical, electrical and climatic tests and their requirements shall be as specified in Table 2.

12. TECHNICAL INFORMATION

12.1 Nominal Internal Width and Operating Frequency Range — Alternate sizes in the tables have been chosen from two staggered series, each covering the frequency range in steps with a frequency ratio of approximately 1·5. The approximate nominal frequency range is from 1·25 to 1·9 fc (fc = cut-off frequency of dominant mode). For any particular type of application, the effective frequency range may be smaller or greater than the nominal frequency range.

12.2 Theoretical Power Rating — The values quoted are the theoretical breakdown values at a frequency 1·5 times the cut-off frequency (assuming breakdown in air at normal temperature and pressure to occur at 30 000 V/cm). The figures quoted include a power safety factor of two as well as allowance for a voltage standing wave ratio of 2·0.

For other frequencies the values given should be multiplied by:

$$1{\cdot}34\,[\,1-(fc/f)^2\,]^{\frac{1}{2}}$$

12.3 Ratio Between Inside Width and Height — The ratio of inside width to inside height is in principle 2 : 1. For some types of waveguides given in this specification this ratio has not been observed, because a different value of ratio was already in extensive use.

12.4 Theoretical Attenuation — The values given in the table are based on a figure for resistivity of copper 1·724 1 × 10^{-8} ohm metre and apply to a frequency equal to 1·5 fc. For general case, attenuation is given by the the formula given in **9.3.1** of IS : 4493 (Part I) - 1979*.

For other materials, the figures quoted should be multiplied by the values specified in **5.1** of IS : 4493 (Part I) - 1979*.

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*Specification for hollow metallic waveguides: Part I General requirements and tests (*first revision*).

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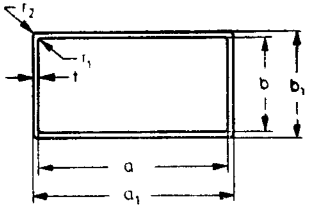

FIG. 1 OUTLINE DRAWING

TABLE 1 ORDINARY RECTANGULAR WAVEGUIDES

All dimensions in millimetres.

(*Clauses* 8.1 *and* 9.1)

TYPE DESIGNATION	FREQUENCY RANGE IN GHz FOR DOMINANT MODE		INSIDE CROSS-SECTION				BASIC WALL THICKNESS *t**	MAXIMUM ALLOWABLE ECCENTRICITY	OUTSIDE CROSS-SECTION					ATTENUATION IN dB/M			CUT-OFF FREQUENCY FOR TE 01 MODE GHz	PEAK POWER RATING MW
	From	To	Basic Width *a*	Basic Height *b*	Deviation of Width and Height ±	Maximum Radius of Corner *r*			Basic Width *a*1	Basic Height *b*1	Deviation of Width and Height ±	Radius of Corner *r*2 *Min*	*Max*	Frequency GHz	Theoretical Value	Maximum Value		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
R 3	0·32	0·49	584·2	292·10	0·06	3·18	4·78	0.25	593·75	301·65	0·06	Under consideration		0·585	0·000 78	0·001 0	0·26	
R 4	0·35	0·53	533·4	266·70	0·06	3·18	4·78	0.25	542·95	276·25	0·06			0·422	0·000 90	0·001 2	0·28	
R 5	0·41	0·62	457·2	228·60	0·51	3·18	3·18	0.25	463·55	234·95	0·51			0·49	0·001 13	0·001 5	0·33	103·0
R 6	0·49	0·75	381·0	190·50	0·38	2·38	3·18	0.25	387·35	196·85	0·38			0·59	0·001 49	0·002	0·39	71·8
R 8	0·64	0·98	292·10	146·05	0·38	2·38	3·18	0·25	298·45	152·40	0·38			0·77	0·002 22	0·003	0·51	45·9
R 9	0·76	1·15	247·65	123·82	0·25	1·59	3·18	0·25	254·00	130·17	0·25			0·91	0·002 84	0·004	0·61	31·9
R 12	0·96	1·46	195·58	97·79	0·25	1·59	3·18	0·25	201·93	104·14	0·25			1·15	0·004 05	0·005	0·77	18·9
R 14	1·13	1·73	165·10	82·55	0·20	1·19	2·03	0·20	169·16	86·61	0·20	1	1·5	1·36	0·005 22	0·007	0·91	13·5
R 18	1·45	2·20	129·54	64·77	0·20	1·19	2·03	0·20	133·60	68·83	0·20	1	1·5	1·74	0·007 49	0·010	1·16	8·29
R 22	1·72	2·61	109·22	54·61	0·20	1·19	2·03	0·20	113·28	58·67	0·20	1	1·5	2·06	0·009 70	0·013	1·37	5·90
R 26	2·17	3·30	86·36	43·18	0·15	1·19	2·03	0·18	90·42	47·24	0·15	1	1·5	2·60	0·013 8	0·018	1·74	3·80
R 32	2·60	3·95	72·14	34·04	0·15	1·19	2·03	0·15	76·20	38·10	0·15	1	1·5	3·12	0·018 9	0·024	2·08	2·43
R 40	3·22	4·90	58·17	29·08	0·15	1·19	1·63	0·13	61·42	32·33	0·15	0·8	1·3	3·87	0·024 9	0·032	2·58	1·60
R 48	3·94	5·99	47·549	22·149	0·13	0·79	1·63	0·10	50·80	25·40	0·13	0·8	1·3	4·73	0·035 5	0·046	3·15	1·04
R 58	4·64	7·05	40·386	20·193	0·13	0·79	1·63	0·10	43·64	23·44	0·13	0·8	1·3	5·57	0·043 1	0·056	3·71	0·806
R 70	5·38	8·17	34·849	15·799	0·10	0·79	1·63	0·08	38·10	19·05	0·10	0·8	1·3	6·45	0·057 6	0·075	4·30	0·544
R 84	6·57	9·99	28·499	12·624	0·10	0·79	1·63	0·08	31·75	15·88	0·10	0·8	1·3	7·89	0·079 4	0·103	5·26	0·355
R 100	8·20	12·5	22·860	10·160	0·10	0·79	1·27	0·06	25·40	12·70	0·10	0·65	1·15	9·84	0·110	0·143	6·56	0·229
R 120	9·84	15·0	19·050	9·525	0·08	0·79	1·27	0·06	21·59	12·06	0·08	0·65	1·15	11·8	0·133	↑ Under consideration ↓	7·87	0·178
R 140	11·9	18·0	15·799	7·899	0·06	0·4	1·02	0·06	17·83	9·93	0·08	0·5	1·0	14·2	0·176		9·49	0·123
R 180	14·5	22·0	12·954	6·477	0·06	0·4	1·02	0·06	14·99	8·51	0·08	0·5	1·0	17·4	0·238		11·57	0·083
R 220	17·6	26·7	10·668	4·318	0·05	0·4	1·02	0·06	12·70	6·35	0·08	0·5	1·0	21·1	0·370		14·05	0·048
R 260	21·7	33·0	8·636	4·318	0·051	0·4	1·02	0·06	10·67	6·35	0·08	0·5	1·0	26·0	0·435		17·36	0·037
R 320	26·3	40·1	7·112	3·556	0·038	0·4	1·02	0·05	9·14	5·59	0·05	0·5	1·0	31·6	0·583		21·08	0·025
R 400	32·9	50·1	5·690	2·845	0·025	0·25	1·02	0·05	7·72	4·88	0·05	0·5	1·0	39·5	0·815		26·31	0·016
R 500	39·2	59·6	4·775	2·388	0·025	0·25	1·02	0·05	6·81	4·42	0·05	0·5	1·0	47·1	1·060		31·39	0·010
R 620	49·8	75·8	3·759	1·880	0·025	0·20	1·02	0·05	5·79	3·91	0·05	0·5	1·0	59·8	1·52		39·88	0·007
R 740	60·5	91·9	3·098 8	1·549 4	0·013	0·15	1·02	0·05	5·13	3·58	0·05	0·5	1·0	72·6	2·02		48·37	0·005
R 900	73·8	112	2·540 0	1·270 0	0·013	0·15	1·02	0·05	4·57	3·30	0·05	0·5	1·0	88·5	2·7		59·01	0·003
R 1200	92·2	140	2·032 0	1·016 0	0·008	0·08	0·51	0·03	3·56	2·540	0·025	0·5	0·8	110·7	3·8		73·77	0·002
R 1400	113	173	1·651 0	0·825 5	0·006	0·04	0·51	0·03	3·175	2·350	0·025	0·5	0·8	136·2	5·2		90·79	0·001 4
R 1800	145	220	1·295 4	0·647 7	0·006	0·04	0·51	0·03	2·819	2·172	0·025	0·5	0·8	173·6	7·5		115·75	0·000 85
R 2200	172	261	1·092 2	0·546 1	0·005	0·04	0·51	0·03	2·616	2·070	0·025	0·5	0·8	205·9	9·7		137·27	0·000 60
R 2600	217	330	0·863 6	0·431 8	0·005	0·04	0·51	0·03	2·388	1·956	0·025	0·5	0·8	260·2	13·8		173·49	0·000 37

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TABLE 2 TEST SCHEDULE AND REQUIREMENTS

(*Clause* 11.2)

METHOD OF MEASUREMENT

Sl No.	Test	Clause Ref in IS : 4493 (Part I)-1979*	Requirements [Clause Ref in IS : 4493 (Part I) - 1979*]
(1)	(2)	(3)	(4)
1.	All samples		
	a) Visual examination	9.4.1	9.4.1
	b) Dimensions	9.4.2	The dimensions and tolerance thereon shall conform to values given in Table 1 read with Fig. 1 of this standard
	c) Bow	9.4.3	9.4.3
	d) Twist	9.4.4	9.4.4
	e) Squareness of cut	9.4.5	9.4.5
2.	*First Group*		
	a) Surface roughness	9.4.8	9.4.8
	b) Scratches	9.4.6	9.4.6
3.	*Second Group*		
	a) Internal stresses	9.4.9	9.4.9
	b) Hardness	9.4.7	9.4.7
4.	*Third Group*		
	a) Attenuation	9.3.1	9.3.1
5.	*Fourth Group*	9.5	
	a) Dry heat	9.5.1	—
	i) Visual examination		There shall be no mechanical deterioration
	ii) Bow	9.4.3	9.4.3
	iii) Rectangularity of cross-section	9.4.2.1	9.4.2.1
	iv) Twist	9.4.4	9.4.4
	b) Cold	9.5.2	After recovery under standard atmospheric conditions, measurements specified as in dry heat test shall be made and the corresponding requirements shall be met as specified
	c) Rapid change of temperature	9.5.3	After recovery under standard atmospheric conditions, measurements specified as in dry heat test shall be made and the corresponding requirements shall be met as specified

*Specification for hollow metallic waveguides: Part I General requirements and tests (*revised*).

INDIAN STANDARDS

ON

MICROWAVE COMPONENTS AND ACCESSORIES

IS :

1885 (Part XIII/Sec 1) - 1968 Electrotechnical vocabulary: Part XIII Telecommunication transmission lines and waveguides, Section 1 General transmission lines

1885 (Part XIII/Sec 2) - 1967 Electrotechnical vocabulary: Part XIII Telecommunication transmission lines and waveguides, Section 2 Microwave transmission lines and waveguides

2032 (Part XIV) - 1971 Graphical symbols used in electrotechnology: Part XIV Microwave technology

4493 (Part I) - 1979 Hollow metallic waveguides: Part I General requirements and tests (*first revision*)

4493 (Part II) - 1981 Hollow metallic waveguides: Part II Ordinary rigid rectangular waveguides

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

Quantity	*Unit*	*Symbol*
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

Quantity	*Unit*	*Symbol*
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

Quantity	*Unit*	*Symbol*	*Definition*
Force	newton	N	1 N = 1 kg.m/s^2
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m^2
Frequency	hertz	Hz	1 Hz = 1 c/s (s^{-1})
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m^2

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